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## Continuous Optical 3D Printing of Green Aliphatic Polyurethanes.

**Journal:** ACS Appl Mater Interfaces

**Publication Year:** 2017

**Authors:** Sang-Hyun Pyo, Pengrui Wang, Henry H Hwang, Wei Zhu, John Warner, Shaochen Chen

**PubMed link:** 27935681

**Funding Grants:** Development of 3D Bioprinting Techniques using Human Embryonic Stem Cells Derived Cardiomyocytes for Cardiac Tissue Engineering

### Public Summary:

We report the first-time continuous optical 3D printing using green aliphatic polyurethanes (gPUs). Photo-sensitive diurethane monomers are prepared from six-membered cyclic carbonate functionalized with methacrylate and biogenic amines. The synthesized monomers are then polymerized to isocyanate-free gPU by UV crosslinking using a continuous optical printing (COP) method. 3D structures with user-defined mechanical properties and biologically relevant structures are printed in mere seconds with a high throughput and resolution by COP. The physical properties of gPU structures are characterized on the transparency, stiffness, and thermal behavior. Finally, the biocompatibility of the gPUs was studied by seeding cells on top of the structures. The technology developed in this work can be used to tailor-make novel gPU materials with specific properties and fabrication process from various functional cyclic carbonates and polyamines. Such printable isocyanate-free gPU materials could fulfill the demands to critical safety issues required in biomedical and consumer products applications. 3D-printed gPU devices could have broader applications such as mechanically strong and durable medical implants, tissue engineering scaffolds, micro-fluidic devices, diagnostic probes, and lab-on-a-chip systems.

### Scientific Abstract:

Photosensitive diurethanes were prepared from a green chemistry synthesis pathway based on methacrylate-functionalized six-membered cyclic carbonate and biogenic amines. A continuous optical 3D printing method for the diurethanes was developed to create user-defined gradient stiffness and smooth complex surface microstructures in seconds. The green chemistry-derived polyurethane (gPU) showed high optical transparency, and we demonstrate the ability to tune the material stiffness of the printed structure along a gradient by controlling the exposure time and selecting various amine compounds. High-resolution 3D biomimetic structures with smooth curves and complex contours were printed using our gPU. High cell viability (over 95%) was demonstrated during cytocompatibility testing using C3H 10T1/2 cells seeded directly on the printed structures.

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